

# synl'ght - die größte künstliche Sonne der Welt

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A large, high-resolution image of the Earth from space occupies the bottom right portion of the slide. It shows a curved horizon with a deep blue atmosphere, white clouds swirling over a green and brown landmass, likely Europe and North Africa.

Knowledge for Tomorrow

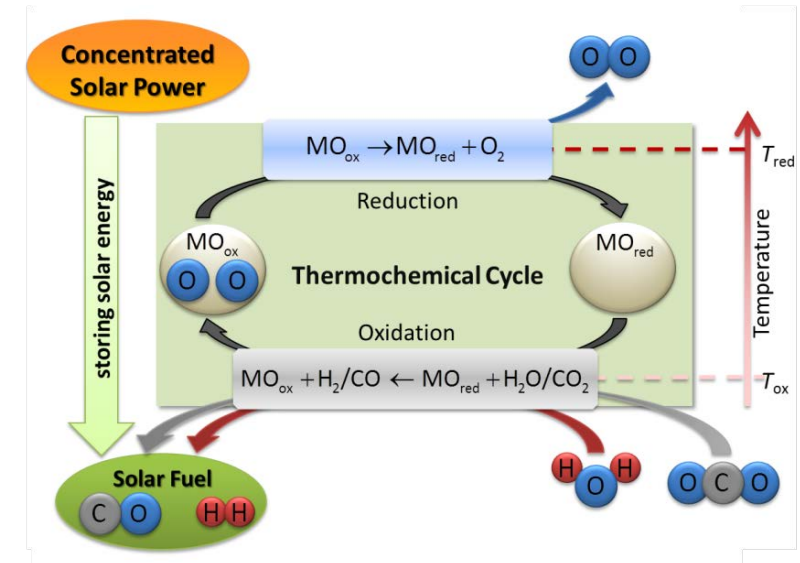
# synlight Large-Scale Solar Simulator (“Artificial Sun”)

## Purpose:

Generation of precisely adjustable and consistent sunlight in a new magnitude for research and industry

## Application: Testing and qualification of

- Thermochemical processes and reactors for solar fuels
- CSP components (receivers)
- Components exposed to high solar / UV radiation
- Applications for highest temperatures up to 3000°C

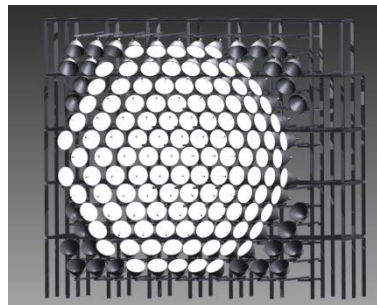


Bridging solar laboratory scale with research platforms and demo plants for **faster technology developments**



— Factor ~10 →

DLR High-Flux Solar Simulator, Cologne, up to 20 kW<sub>rad</sub>



— Factor ~10 →

Synlight, Jülich, up to 300 (400) kW<sub>rad</sub>

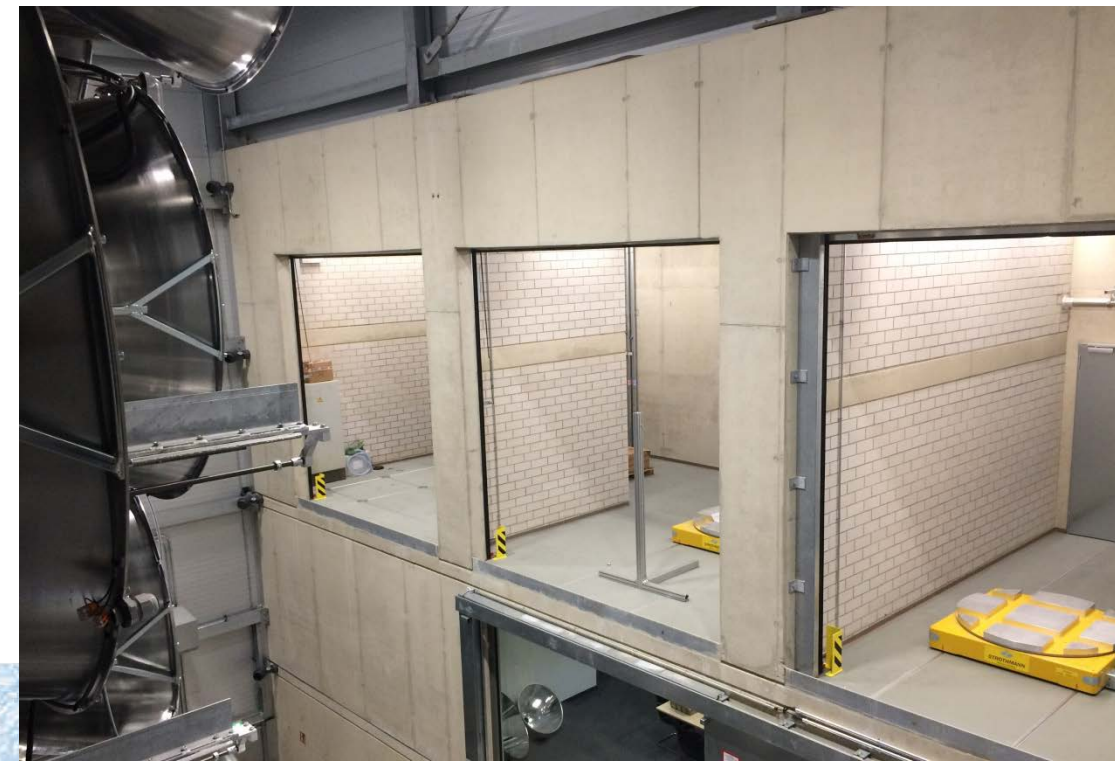
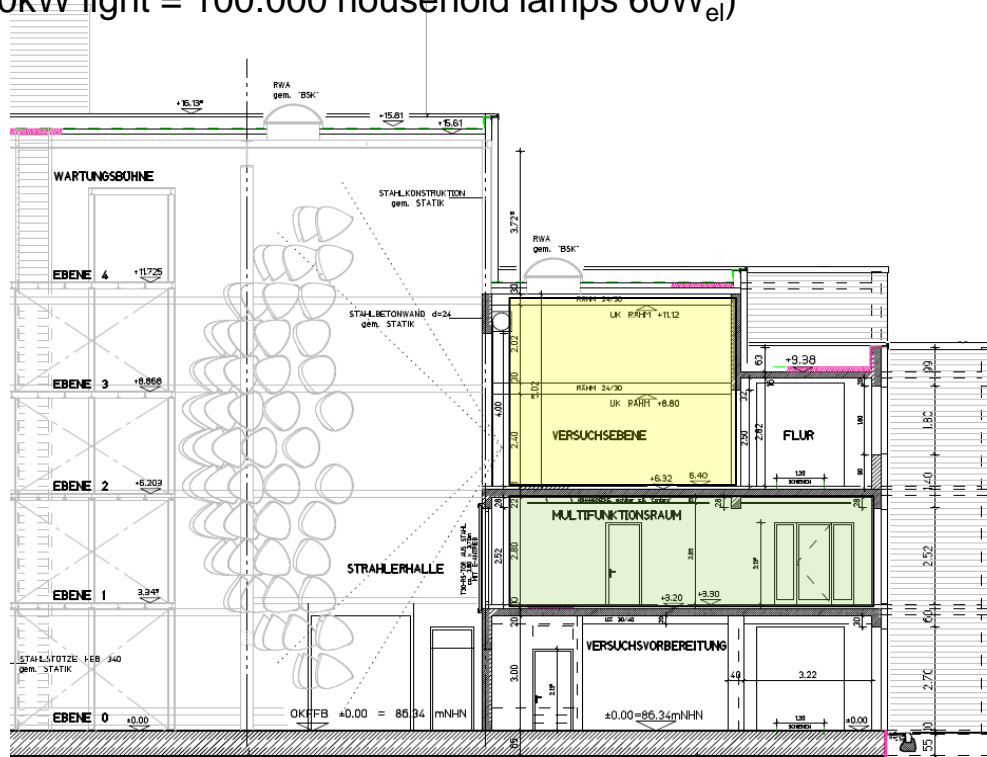
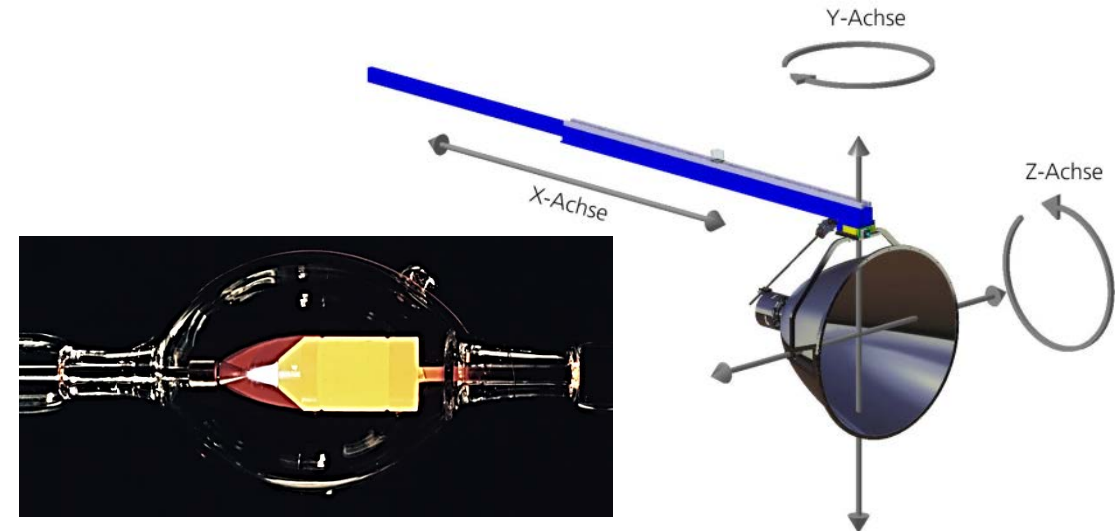


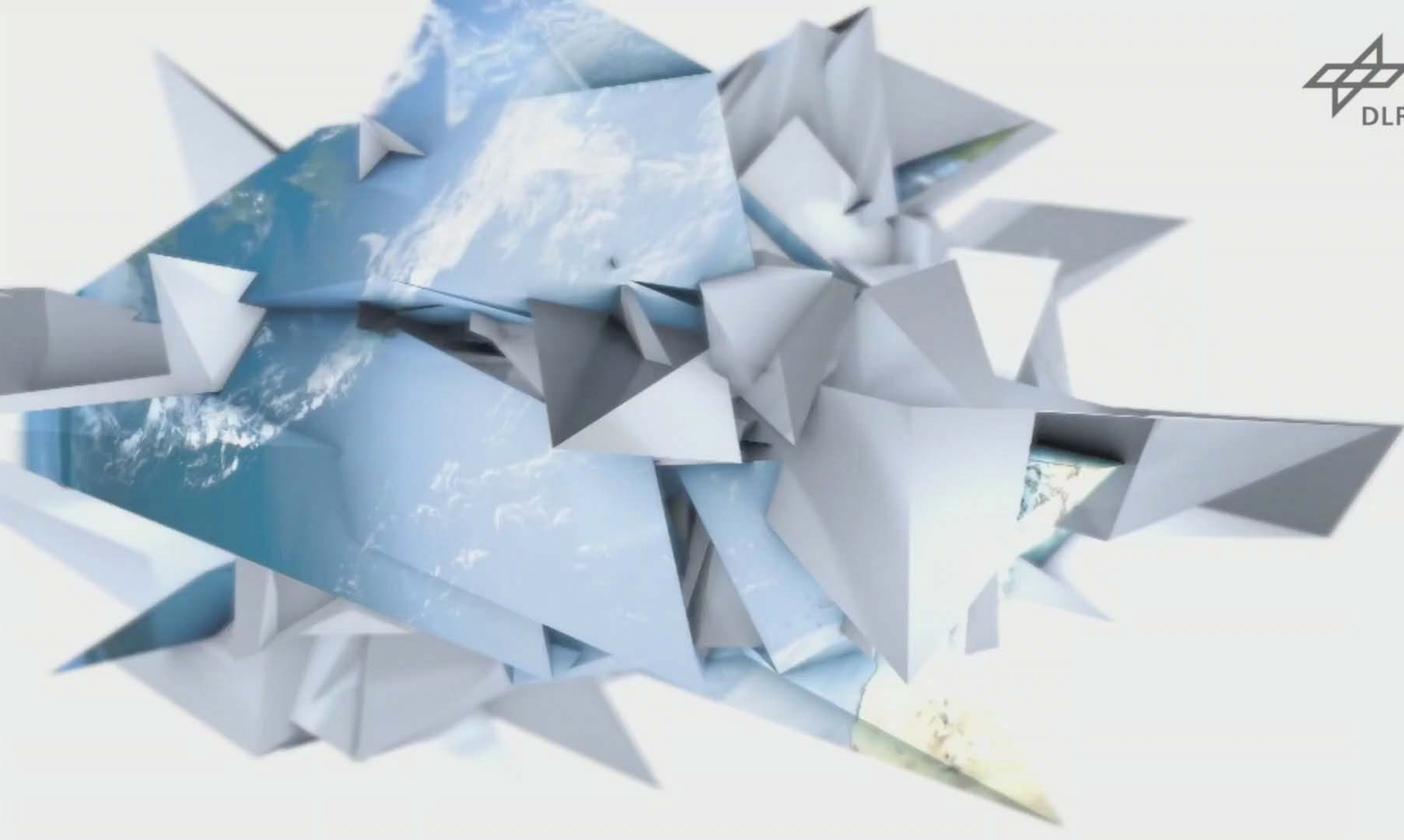
Research platforms of Jülich Solar Tower and a future 2nd tower, up to 1000 / 2000 kW<sub>rad</sub>



# synlight Technical Implementation

- 149 identical modules, computerized adjustable in 3 axis
- $7\text{kW}_{\text{el}}$ - ( $10\text{kW}_{\text{el}}$ -) Xenon cinema lamps as light sources with a light nearly equal to the solar spectrum
- Light concentration up to 10.000 times /  $>3000^{\circ}\text{C}$
- Building with 3 test chambers, independent operation, specially equipped
- Radiation powers:  $240\text{kW}$  /  $300\text{kW}$  /  $240\text{kW}$  (maximum with  $10\text{kW}_{\text{el}}$  bulbs:  $320\text{kW}$  /  $400\text{kW}$  /  $320\text{kW}$ )  
(Note:  $300\text{kW}$  light = 100.000 household lamps  $60\text{W}_{\text{el}}$ )





# Worldwide existing High-Flux Solar Simulators

Point-focusing, >7.5kW, as far as known, data from latest publications

Operator / High-Flux Solar Simulator	Operation	Solar Power [kW]	Electric Power [kW]	Lamps	Peak Flux [MW/m <sup>2</sup> ]	SB Temp.** [°C]
<b>DLR, Synlight, Jülich</b>	<b>2017</b>	<b>300 (400)* 240 (320)* 240 (320)*</b>	<b>149 x 7 (149 x 10)</b>	<b>Xe</b>	<b>&gt;11*</b>	<b>&gt;3460*</b>
Paul-Scherrer-Institut, Zürich	2005	50	10 x 15	Xe	11.0	3460
Niigata University	2013	30	19 x 7	Xe	3.2	2470
<b>DLR, Hochleistungsstrahler, Köln</b>	<b>2007</b>	<b>20</b>	<b>10 x 6</b>	<b>Xe</b>	<b>4.2</b>	<b>2660</b>
Aristotle University, Thessaloniki	2013	20	11 x 6	Xe	4.8	2760
North China Electric Power University	2016	20	7 x 10	Xe	4.0	2360
KTH Stockholm, Solar Lab	2014	19.7	12 x 7	Xe	6.7	3020
University of Florida	2011	14	7 x 6	Xe	5.0	2790
IMDEA, Madrid	2013	14	7 x 6	Xe	3.6	2530
Swinburne University, Melbourne	2015	12	7 x 6	MH	0.9	1740
University of Colorado, Boulder	2016	10*	18 x 2.5	Xe	*	*
University of Minnesota	2010	9.2	7 x 6.5	Xe	7.3	3100
Australian National University	2015	8.4	18 x 2.5	Xe	3.0	2420
EPFL Lausanne, LRESE	2015	7.5	18 x 2.5	Xe	3.8	2590

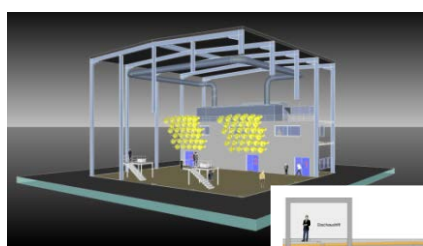
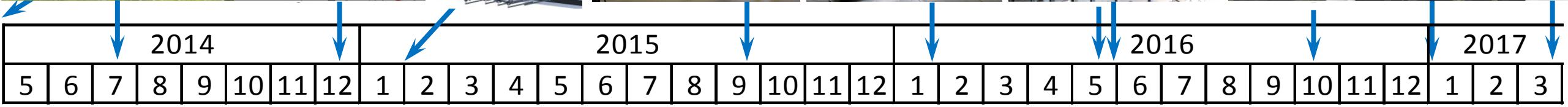
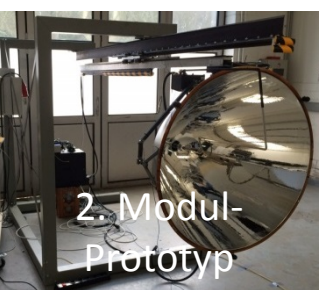
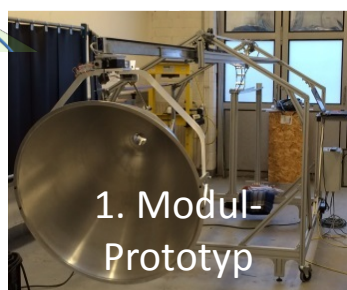
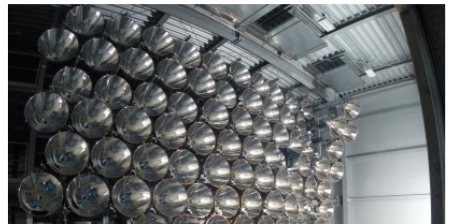
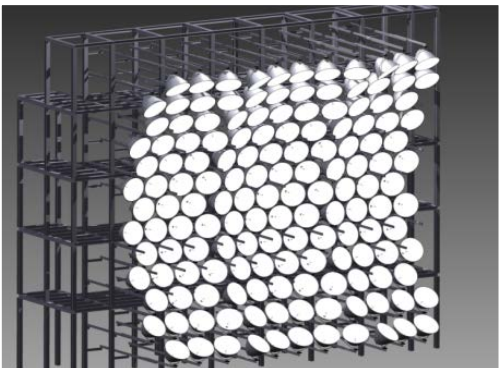
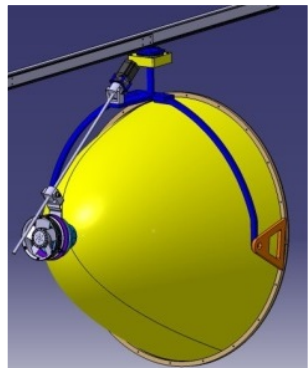
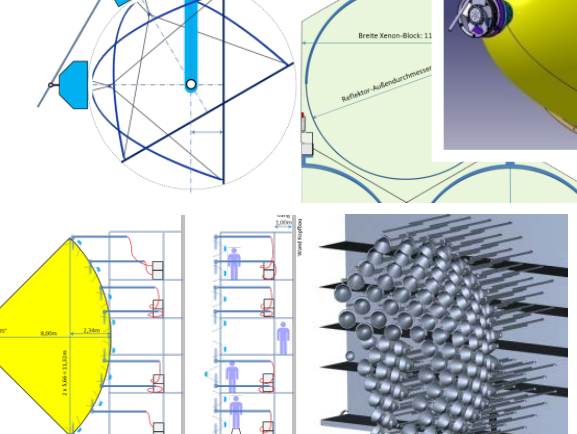
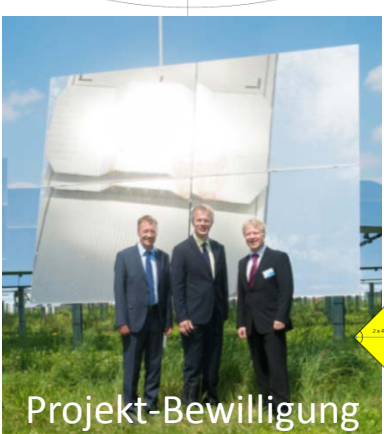
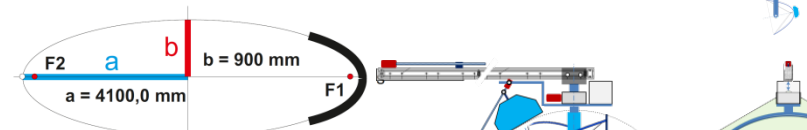
\* Design values, not yet been demonstrated / published

\*\* Max. total temperature on ideal black body acc. to Stefan-Boltzmann law

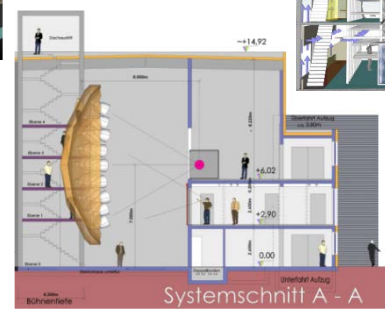




# Synlight-Entwicklung

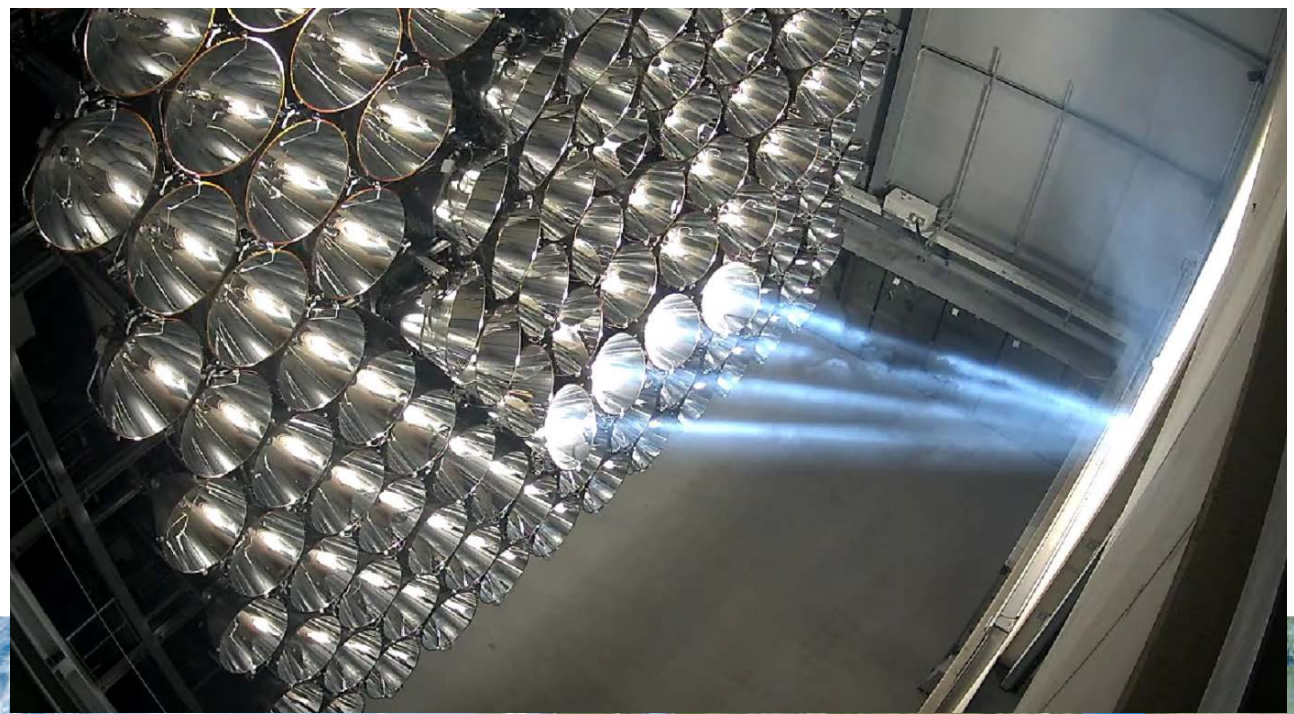
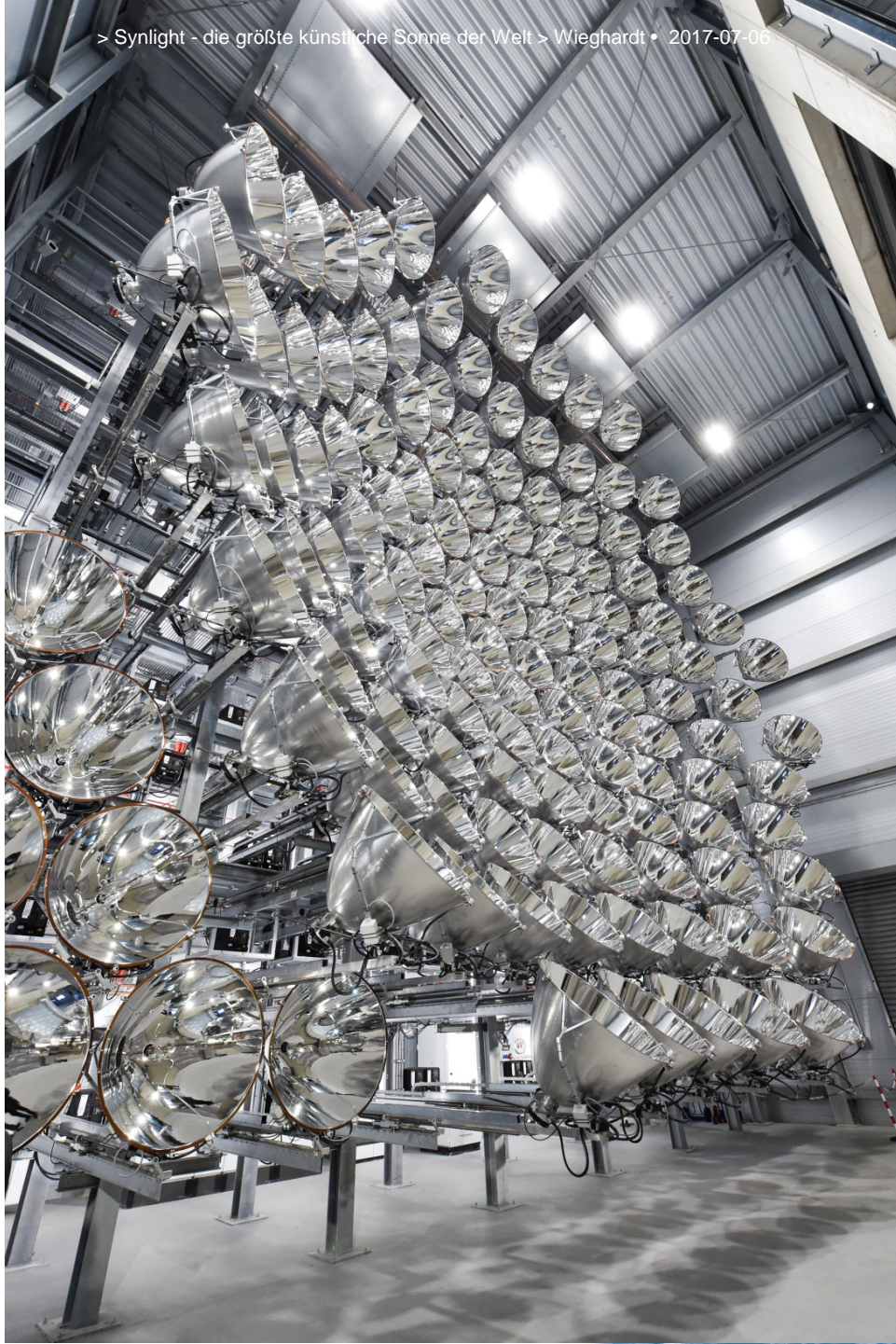


Jülich: B-Plan  
Bauantrag



Festlegung Gebäude-Topologie

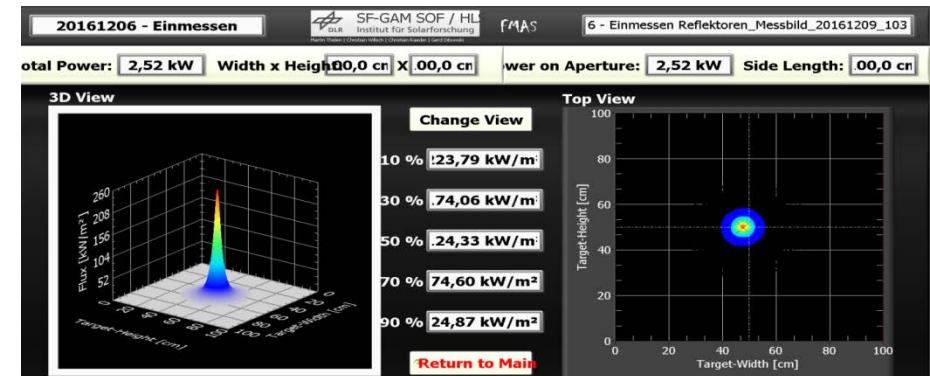






## Current Work and Outlook

- 04-06/17 Commissioning & improvements
  - Adjustment of lamps & shaping of reflectors after erection
  - Precise alignment of modules in framework
  - Improvements of control software
  - Operation with 55 modules /  $130\text{kW}_{\text{rad}}$  on air-cooled SOL2HY2 reactor (until quartz glass window failed)
- 23.03.17 - Great media and visitor's interest
  - Q1/17: Synlight with 547 media reports: 2<sup>nd</sup> highest media resonance in DLR history (after "Rosetta")
  - Q2/17: BBC, CNN, Discovery Channel, Al Jazeera, RTL, ...
- 07/17 Verification of power and flux using FMAS
- 07/17 Erection of mHLS hydrogen reactor
- 08/17 - 06/18 Demonstration of  $\text{H}_2$  production with mHLS reactor
- 2018 - Projects INDIREF and ASTOR (DLR Solar Research)



**Test capacity is still available. We are looking for cooperative research partners**

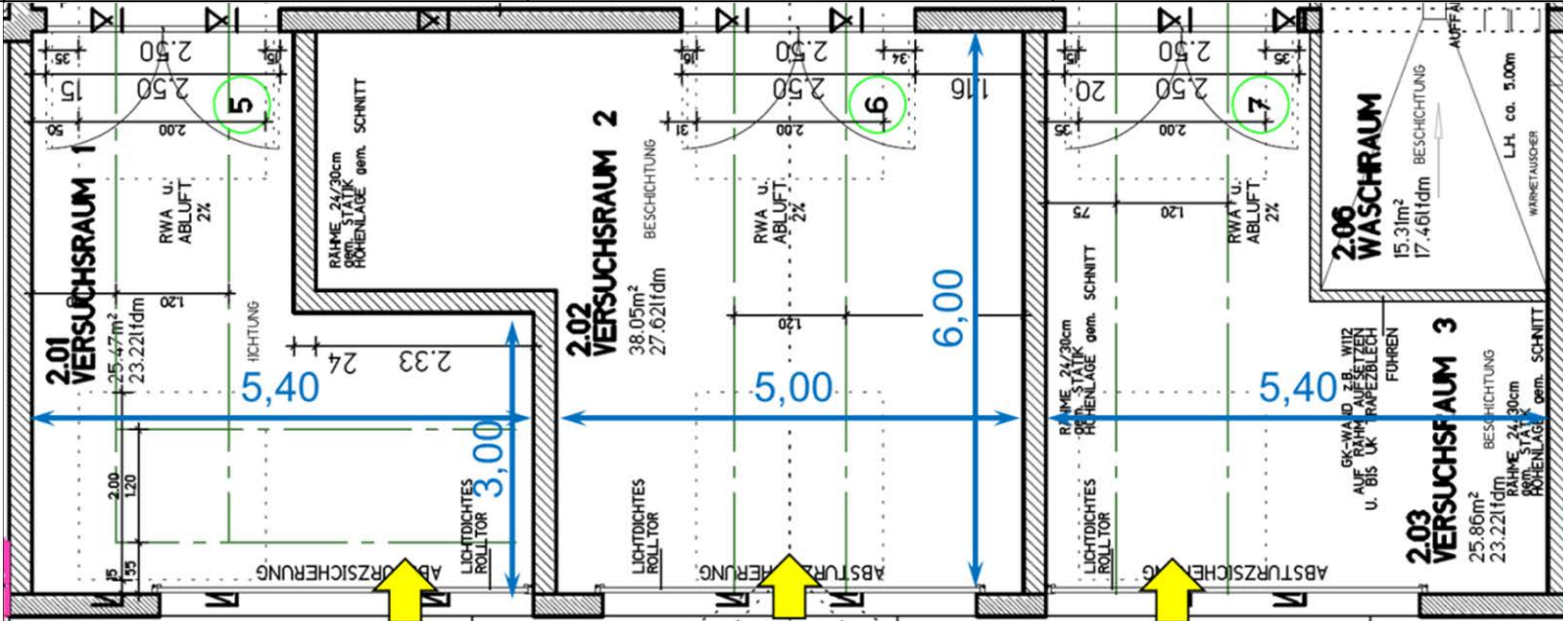




# synlight

## Technical Profile

Floor plan

	Test Chamber 1	Test Chamber 2	Test Chamber 3
			
Max. solar power	240kW* (320kW*)	300kW* (400kW*)	240kW* (320kW*)
Peak flux	>8MW/m²*	>11MW/m²*	>8MW/m²*
Max. aperture	2m x 2m (4m x 4m)		
Chamber space	25m² x 4,5m	38m² x 4,5m	26m² x 4,5m
Max. test object	2,5t (>4t)	2,5t (>6t)	2,5t (>4t)
Cooling	air cooling up to 5m³/s per chamber, additional cooling water supply		
Connections	power 400V/63A and 230V/16A, water 100L/min, Ethernet 1Gbit/s		
Special feature	high UV proportion	equipped for solar-chemical applications	

\* Predicted values. Parameters in brackets () exceed the current standard and can be realized with some additional effort.





synlight

Die größte künstliche Sonne der Welt

Gefördert durch:

Ministerium für Klimaschutz, Umwelt,  
Landwirtschaft, Natur- und Verbraucherschutz  
des Landes Nordrhein-Westfalen



Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Energie

aufgrund eines Beschlusses  
des Deutschen Bundestages